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MEMORANDUM

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SUBJECT: EXPOSURES TO 1,3-DICHLOROPROPENE IN MONTEREY AND SANTA
CRUZ COUNTIES BASED ON THE FALL 2000 MONITORING BY THE
CALIFORNIA AIR RESOURCES BOARD

This memorandum gives inhalation exposures as average concentrations of 1,3 dichloropropene (1,3-D) in air for 24-hour, 1-week and 8-week averaging periods, based on monitoring done by the California Air Resources Board in Monterey and Santa Cruz Counties in Fall 2000 (ARB, 2001).

Methods

Following the practice of the Worker Health and Safety (WHS) Branch, this memorandum reports arithmetic mean concentrations and tolerance limits estimated using lognormal methods. Lognormality is assumed for environmental contaminants in most cases. DPR's experience with many large environmental datasets has shown that they are usually well described by the lognormal distribution. In addition, WHS prefers to avoid the inconsistency of using different exposure statistics based on sample characteristics. WHS uses the arithmetic mean concentration because the concentration of interest for exposure assessment is the overall concentration in all of the air that a person could breathe during the averaging period. The arithmetic mean concentration is the best estimate of the average mass of residue per unit of environmental medium; it is equivalent to compositing all of the samples and measuring the concentration of the mixture (Parkhurst, 1998). This is true regardless of the shape of the underlying distribution.

Fourteen samples with flow-rate deviations greater than 25% were excluded from the analysis. Of 219 usable samples, 34 contained quantifiable concentrations of both cis- and trans-1,3-D (above the limits of quantitation (LOQ) of 0.009 and 0.013 ppbv, respectively). 143 samples were below the limits of detection (LOD) for both cis- and trans-1,3-D (0.002 and 0.003 ppbv, respectively), 16 samples were between the LOD and LOQ for both isomers, and 26 samples had different status for the two isomers. Before the cis- and trans- concentrations were summed to get total 1,3-D for each sample, one-half the LOD was substituted for an isomer below the LOD, and midpoint(LOD,LOQ) was substituted for an isomer below the LOQ. Where there were two samples from a site for one day, the two values were averaged. In two cases, sites had usable samples for only two days in a week. The data were not adjusted for recovery (average 90% in 4 laboratory spikes, 87% in 4 trip spikes and 105% in 4 field spikes).

24-hr exposure

For each monitoring site separately, the maximum observed and the 95% tolerance limit for 24-hr concentrations are given. The 95% tolerance limit is the concentration that, with given probability, will be exceeded in 5% of future samples (Hahn and Meeker, 1991). It is calculated using lognormal distribution methods:

$$95\% \text{ tolerance limit} = \exp\{\text{arithmetic mean of log concentrations} + g_{(.90,.95; n)} * (\text{sd of logs})\}.$$

The multiplier g for 90% probability is tabled in Hahn and Meeker (1991).

1-week exposure

For each monitoring site separately, the maximum and the 95% tolerance limit for weekly mean concentrations are given. Each weekly mean is calculated as the arithmetic mean of the 24-hr samples taken at a site during the week (i.e., nonmonitoring days are ignored). The 95% tolerance limit for weekly mean concentrations is calculated using normal distribution methods:

$$95\% \text{ tolerance limit} = \text{arithmetic mean of week means} + g_{(.90,.95; n)} * (\text{sd of week means}).$$

Normal methods are used in this case because sample means from any distribution tend to be normally distributed.

8-week exposure

For each monitoring site separately, average exposure over the 8-week monitoring period is calculated as the arithmetic mean of the weekly means (calculated as above for 1-week exposure).

Results

Twenty-four-hour, 1-week and 8-week concentrations are presented in Table 1. Daily concentrations and intermediate calculations are shown in Table 2.

**Table 1. 1,3-dichloropropene concentrations (ppbv) in Monterey and Santa Cruz Counties, 11 September – 2 November 2000
 based on monitoring by the California Air Resources Board.**

Site ^a	N days	Daily		1-week		8-week
		Maximum 24-hr	95% tolerance limit	Maximum weekly ^b mean	95% tolerance limit	Mean of weekly means
		----- ppbv -----				
CHU	31	0.96	0.86	0.45	0.51	0.09
LJE	29	0.07	0.03	0.02	0.02	0.01
OAS	29	0.32	0.26	0.13	0.16	0.04
PMS	31	0.79	0.41	0.24	0.33	0.06
SAL	30	0.08	0.04	0.04	0.04	0.01
SES	29	0.06	0.03	0.02	0.03	0.01

^a Monitoring sites described in ARB (2001).

^b Each weekly mean is the arithmetic mean of the daily averages (*n* ranged 2 - 4) in a calendar week.

Exposure appraisal

The average concentrations presented here are based on limited monitoring data and must be considered as having some degree of uncertainty. The representativeness of the six monitoring sites is unknown. Each site was monitored 2 - 4 days per week for a relatively short (8-week) period. Weekend days were not monitored. It is unknown whether weekdays and weekends differ systematically in numbers of 1,3-D fumigations.

References

- ARB. 2001. Ambient air monitoring for methyl bromide and 1,3-dichloropropene in Monterey/Santa Cruz Counties - Fall 2000. Final report dated Jan. 31, Project No. C00-028. Sacramento, CA: Engineering and Certification Branch, Monitoring and Laboratory Division, Air Resources Board, California Environmental Protection Agency.
- Hahn, G.J., and Meeker, W.Q. 1991. *Statistical Intervals: A Guide for Practitioners*. New York, John Wiley & Sons, Inc.
- Parkhurst, D.F. 1998. Arithmetic versus geometric means for environmental concentration data. *Environmental Science and Technology News*. Feb. 1.

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Table 2. Daily concentrations and intermediate calculations for Monterey/Santa Cruz County sites.

Day	Week	CHU	LJE	OAS	PMS	SAL	SES	CHU	LJE	OAS	PMS	SAL	SES
		ppbv						ln(ppbv)					
11-Sep-00	1	0.5015	0.0023	0.0617	0.0685	0.0280	0.0061	-0.69	-6.09	-2.79	-2.68	-3.58	-5.10
12-Sep-00	1	0.9555	0.0023	0.1359	0.0570	0.0081	0.0063	-0.05	-6.09	-2.00	-2.87	-4.81	-5.06
13-Sep-00	1	0.3507	0.0663	0.2503	0.0056	0.0061		-1.05	-2.71	-1.38	-5.19	-5.10	
14-Sep-00	1	0.0023	0.0023	0.0801	0.1149	0.0023	0.0415	-6.09	-6.09	-2.52	-2.16	-6.09	-3.18
1 Average		0.4525	0.0183	0.1320	0.0615	0.0111	0.0180						
18-Sep-00	2	0.1798	0.0023	0.0135	0.7917	0.0135		-1.72	-6.09	-4.31	-0.23	-4.31	
19-Sep-00	2	0.1355	0.0023	0.0135	0.1490	0.0023	0.0599	-2.00	-6.09	-4.31	-1.90	-6.09	-2.81
20-Sep-00	2	0.0023	0.0023	0.0445	0.0023	0.0023	0.0023	-6.09	-6.09	-3.11	-6.09	-6.09	-6.09
21-Sep-00	2	0.0135		0.0023	0.0023	0.0023	0.0023	-4.31		-6.09	-6.09	-6.09	-6.09
2 Average		0.0828	0.0023	0.0184	0.2363	0.0051	0.0215						
25-Sep-00	3	0.0023	0.0023		0.0023	0.0023	0.0023	-6.09	-6.09		-6.09	-6.09	-6.09
26-Sep-00	3	0.0023	0.0023	0.0056	0.0023	0.0023	0.0023	-6.09	-6.09	-5.19	-6.09	-6.09	-6.09
27-Sep-00	3	0.0023	0.0023	0.0023	0.0023	0.0023	0.0089	-6.09	-6.09	-6.09	-6.09	-6.09	-4.73
28-Sep-00	3	0.0023	0.0023	0.0023	0.0135	0.0023	0.0023	-6.09	-6.09	-6.09	-4.31	-6.09	-6.09
3 Average		0.0023	0.0023	0.0034	0.0051	0.0023	0.0039						
2-Oct-00	4	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	-6.09	-6.09	-6.09	-6.09	-6.09	-6.09
3-Oct-00	4	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	-6.09	-6.09	-6.09	-6.09	-6.09	-6.09
4-Oct-00	4	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	-6.09	-6.09	-6.09	-6.09	-6.09	-6.09
5-Oct-00	4	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	-6.09	-6.09	-6.09	-6.09	-6.09	-6.09
4 Average		0.0023	0.0023	0.0023	0.0023	0.0023	0.0023						
10-Oct-00	5	0.0023	0.0023		0.0023		0.0023	-6.09	-6.09		-6.09		-6.09
11-Oct-00	5	0.0023	0.0023	0.0089	0.0023	0.0023	0.0023	-6.09	-6.09	-4.73	-6.09	-6.09	-6.09
12-Oct-00	5	0.0023	0.0023	0.0023	0.0179	0.0023	0.0023	-6.09	-6.09	-6.09	-4.02	-6.09	-6.09
5 Average		0.0023	0.0023	0.0056	0.0075	0.0023	0.0023						
16-Oct-00	6	0.0180	0.0135	0.0023	0.0196	0.0773	0.0023	-4.02	-4.31	-6.09	-3.93	-2.56	-6.09
17-Oct-00	6	0.1088	0.0204	0.0023	0.0023	0.0556	0.0023	-2.22	-3.89	-6.09	-6.09	-2.89	-6.09
18-Oct-00	6	0.2148	0.0023	0.0135	0.0023	0.0023	0.0135	-1.54	-6.09	-4.31	-6.09	-6.09	-4.31
19-Oct-00	6	0.0910	0.0135	0.0020	0.0207	0.0188	0.0213	-2.40	-4.31	-6.21	-3.88	-3.97	-3.85
6 Average		0.1082	0.0124	0.0050	0.0112	0.0385	0.0098						

continued

Table 2. Continued.

Day	Week	CHU	LJE	OAS	PMS	SAL	SES	CHU	LJE	OAS	PMS	SAL	SES
ppbv								ln(ppbv)					
23-Oct-00	7	0.0135	0.0135	0.0089	0.6658	0.0023	0.0089	-4.31	-4.31	-4.73	-0.41	-6.09	-4.73
24-Oct-00	7	0.0023		0.0023	0.0960	0.0023	0.0089	-6.09		-6.09	-2.34	-6.09	-4.73
25-Oct-00	7	0.0263	0.0231	0.0023	0.0135	0.0160	0.0023	-3.64	-3.77	-6.09	-4.31	-4.13	-6.09
26-Oct-00	7	0.0023	0.0023	0.0948	0.0023	0.0089	0.0089	-6.09	-6.09	-2.36	-6.09	-4.73	-4.73
7 Average		0.0111	0.0130	0.0271	0.1944	0.0073	0.0072						
30-Oct-00	8	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	-6.09	-6.09	-6.09	-6.09	-6.09	-6.09
31-Oct-00	8	0.0089	0.0023	0.0023	0.0023	0.0023	0.0023	-4.73	-6.09	-6.09	-6.09	-6.09	-6.09
1-Nov-00	8	0.0023	0.0023	0.0023	0.0135	0.0023	0.0023	-6.09	-6.09	-6.09	-4.31	-6.09	-6.09
2-Nov-00	8	0.1211	0.0184	0.3228	0.0023	0.0069	0.0023	-2.11	-4.00	-1.13	-6.09	-4.98	-6.09
8 Average		0.0336	0.0063	0.0824	0.0051	0.0034	0.0023						
Mean of week means		0.087	0.007	0.035	0.065	0.009	0.008	-4.46	-5.56	-4.84	-4.71	-5.43	-5.48
SD of week means		0.153	0.006	0.048	0.095	0.012	0.008	2.07	0.99	1.68	1.84	1.07	0.97
Max of week means		0.452	0.018	0.132	0.236	0.038	0.021	31	29	29	31	30	29
	n weeks	8	8	8	8	8	8						
95th %ile of week means		0.38	0.019	0.125	0.2	0.03	0.02						
90% tol limit on 95th%		0.509	0.025	0.165	0.328	0.043	0.029	95th %ile of days					
								0.387	0.021	0.137	0.202	0.027	0.022
Max of days		0.956	0.066	0.323	0.792	0.077	0.060	0.855	0.030	0.263	0.408	0.041	0.031
								90% tol limit on 95th%ile of days					